Assessing On-Farm Energy Options

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National Center for Appropriate Technology

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The National Center for Appropriate Technology (www.ncat.org)
Farm Energy Alternatives

The heavy use of fossil-based fuels and fertilizers in the US food system lies at the heart of many of our environmental, health, and national security problems. Sustainable agriculture and sustainable energy are really two sides of the same coin.

The publications, success stories, and links within these pages explain how to make farm buildings more energy efficient, use the sun’s energy to heat greenhouses and pump water, choose and put up wind turbines, make and use biofuels, and much more.

View a comprehensive list of all ATTRA Energy Publications.
Or explore the topic areas below.
1. Stories about farms and energy…why we are all here.

2. How to assess your energy options.

3. Pros and cons of some renewable energy options.

4. Funding opportunities and resources.
Part 1: Stories about farms and energy…why we are all here.
1. Irrigators were far more efficient than we had expected.

2. Energy cost was a low priority for most. Crop yield and quality were far more important.
Myth #1: Farms are to blame for US energy problems.

- Food system: 10% - 17%
- Agricultural production: 1% - 3%

Total US energy consumption

Myth #2: Farms are to blame for the energy intensity of the US food system.

Energy usage in the US food system (Btu).

Myth #3: US farms are highly inefficient.

Energy used per unit of farm output (1996 = 1.0)

(Through diesel engines, efficient tillage practices, crop-drying, irrigation, etc.)

Source: USDA Economic Research Service
Myth #4: Energy efficiency is the key to farm profitability.

Source: USDA Economic Research Service
Could efficiency be overrated…
even part of the problem?

The Small Farm Energy Project (1976-1983)
Rick & Mary Pinkelman Farm, Cedar County, NE

- Solar vertical wall collector.
- Total cost (in 1980) $890.
- Still working.
“Small family farmers are directly threatened by large-scale mechanization developed in an era of cheap energy.”

“The energy crisis is an economic opportunity for America’s small family farmers.”

“The small family farmer can make use of renewable energy resources, demonstrating that skill and resourcefulness...is once again at a premium in agriculture.”
1. Keep animals bunched up.
2. Keep them moving.
3. Maintain a “human presence.”
Part 2: How to assess your energy options.
1. A farm is not a house.
2. Most farms don’t need a professional energy audit.
3. However, it wouldn’t hurt to get the power bills out of your desk drawer. Talk to your utility.
4. You can do your own energy audit.
Click on the picture for a definition.

Answer the questions below.

What is the approximate number of **Incandescent** lamps you use?
0

What is the approximate number of **Tungsten-Halogen** lamps you use?
0

What is the approximate number of **Compact Fluorescent** lamps you use?
0

What is the approximate number of **T-12 Fluorescent** lamps (1-1/2" diameter) you use?
0
5. Work with a dealer.

*(You know the drill.)*
Directory of Energy Alternatives

Add your listing to our directory.
(Or update an existing listing.)

Energy-related businesses, agencies, and non-profit organizations serving agriculture and rural people are welcome to submit or update listings, using our simple self-listing form.
6. You need a third-party energy study to apply for the USDA Rural Energy for America Program.
Who does farm energy audits and feasibility studies?

- Utilities, usually contracting with third parties (e.g. Alliant Energy, PG&E, Southern Cal Edison)
- For-profit companies (e.g. EnSave, GDS Associates)
- State departments of agriculture (e.g. Kentucky, Massachusetts)
- State energy offices (e.g. Texas)
- Farm organizations (e.g. NC Farm Bureau)
- State public benefit corporations (e.g. NYSERDA, Efficiency Vermont)
- Resource Conservation Districts (often in partnership with EnSave)
- Universities (Extension programs, e.g. North Dakota, Montana)
- Other non-profit organizations (NCAT, Maine Rural Partners)
- Independent contractors
Part 3: Pros and cons of some renewable energy options.
Solar Electricity (Photovoltaics)

Advantages

• No Fuel Costs
• Low Maintenance
• Decentralized Power Source
• High Reliability
• Silent
• No Emissions
• Sexy
Solar Site Analysis

- Ideally un-shaded from at least 9:00 AM until 3:00 PM.
- Move array to avoid shading. Or oversize.
Schraudner Ranch, Lavina, MT
Small wind: highly site-specific
A few cautions

- Generally need at least 10 mph average @ 30 meters for small wind turbines & 15 mph for large turbines.
- Check wind maps. Professional site assessment if you can.
- Insist on a power curve. Distrust power outputs. Distrust new designs, vertical axis turbines, and anything bolted to buildings or roofs.
- Be prepared to do your own regular maintenance.
- Mechanical failure a big problem. Older turbines that require more maintenance seem to break down less.
- Expect to pay $7,500 to $15,000 per kW for a small wind turbine with controller and tower.
Importance of “Micro-Siting”

30’ above obstructions within 300 – 500’
Wood: many options to consider
Vegetable Oil and Biodiesel
Thad Doye, Walters, OK

$4.38 per gallon after 3 years
Bob Quinn, Big Sandy, MT

- 4,000 acre organic grain farm
- 5% of acreage could meet all fuel needs
- Experimenting with camelina (biodiesel) and high-oleic safflower oil (SVO).
Piedmont Biofuels and BioFarm, Pittsboro, NC
(www.biofuels.coop)
Small scale ethanol
Wood to biofuel: which conversion technology wins?

Energy Products and Processes for Woody Biomass

- Process Heat
  - Hot Gas or Steam
- Bio-Power
  - Direct Combustion
  - Electricity or Combined Heat and Power (CHP) Turbines
- Logging Residue, Waste Wood, Tops & Branches
  - Pyrolysis 300ºC Torrefaction
  - Pyrolysis 400ºC Bio-Oil
- Bio-Oil
  - Syngas (CO, H₂, CH₄) Alcohol, Fischer-Tropsch Liquids
- Bio-Fuels & Bio-Products
  - Hydrolysis
  - Acids & Enzymes
  - Alcohols
  - Fermentation & Distillation
  - Gasification 500ºC

 Courtesy of Chris Hopkins, NC State University
Flowing Water

- Reliable: water flows 24/7.
- Need significant flow, head, or both.
- Power output easy to estimate.
- Permitting can be a major obstacle.
- Few rules of thumb. Installations vary widely depending on characteristics of the site.
- Currently training our staff.

Courtesy DOE/EERE
Geothermal Heat

- Need open area, well, or pond. Trenches typically 6-8 feet deep and 100-300 feet long.
- Circulates fluid, usually water/antifreeze mix. Electric heat pump extracts warmth from soil.
- Best economics where used for both heating and AC.
- Think $15-$40,000 including drilling, with 5-10 year payback—maybe less with incentives & tax credits.

Drawings courtesy of GeoComfort Geothermal Systems
Animal manure (anaerobic digestion)
Part 4: Funding Opportunities and Resources.
Federal Tax Credit

Residential Renewable Energy Tax Credit 30%; no maximum.


Business Energy Investment Tax Credit 30% for most technologies; no maximum

Residential Energy Efficiency Tax Credit 30%; maximum $1500.

- Eligible: Water Heaters, Furnaces, Boilers, Heat pumps, Central Air conditioners, Building Insulation, Windows, Doors, Roofs, Biomass, Stoves that use qualified biomass fuel

- Read the fine print

- Work with a dealer. They know this stuff.
State Tax Credits, Sales Tax Exemptions, Grant Programs, etc.

- Work with a dealer. They know this stuff.
- DSIRE website: www.dsireusa.org.
Competitive USDA grant and loan energy program: $99 million for FY2010, $109 million (proposed) for 2011.

Administered by USDA Rural Development since 2003.

Grants up to 25% of total eligible project costs.

All rural small businesses are eligible.

Grants: up to 25% of eligible project costs.

Loan guarantees: up to 75% of eligible project costs.

Feasibility studies: up to 25% of cost, $50,000 maximum.

All rural small businesses are eligible – not just farms.

“Rural” = population < 50,000

20% of funds set aside for small projects (grant < $20,000).
Eligible renewable energy technologies

- Energy efficiency
- Solar: thermal & electric (PV)
- Wind: large & small
- Biomass: biofuels, digesters, bioheat, biomass power, pellet plants
- Geothermal: heat pumps, direct geothermal
- Hydrogen
- Hydroelectric
- Algae biodiesel
- Ocean power: wave, current, thermal
REAP grant limits

Renewable Energy
• Grant requests $2,500 to $500,000
• Request over $50,000 requires a feasibility study by a qualified independent consultant.

Energy Efficiency
• Grant requests $1,500 to $2,500,000
• Total project cost over $50,000 requires an energy audit.
Some states are doing better than others.

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Sign me up!

- Contact USDA Rural Development to discuss your project.

**Each state has a Rural Energy Coordinator:**

- **CT, MA, RI:** Charles Dubuc, 401-826-0842, charles.dubuc@ma.usda.gov
- **ME:** John Sheehan, 207-990-9168, john.sheehan@me.usda.gov
- **NH, VT:** Cheryl Ducharme, 802-828-6083, cheryl.ducharme@vt.usda.gov
Publications and Resources
Wind Power Development in South Dakota

Wind power is the fastest growing source of electricity generation in the United States. In a recent report, ELPC summarizes South Dakota's embryonic wind industry, the many benefits of the industry, and offers policy solutions to expand wind development and maximize the benefits for all South Dakotans. (more...)

An American Success Story: The Farm Bill’s Clean Energy Programs

Success Stories
Minwind III-IX
Luverne, Minnesota Utility-Scale Wind Section 9006 Grant: $178,201 Each project - 2003

The MinWind utility-scale wind projects on the wind-rich
Farm Energy

The publications, success stories, and links within these pages explain how to make farm buildings more energy efficient, use the sun's energy to heat greenhouses and pump water, choose and put up wind turbines, make and use biofuels, and much more.

View a comprehensive list of all ATTRA Farm Energy Publications. Or explore the topic areas below.
Call ATTRA with energy questions.

FREE technical assistance and publications.

800-346-9140 (English), 800-411-3222 (Spanish)
In conclusion...

1. Stay bunched up.
2. Keep moving.
3. Keep it human!
Thank you for your attention!

NCAT: www.ncat.org or 1-800-ASK-NCAT

ATTRA: www.attra.org or 1-800-346-9140

Mike Morris: mikem@ncat.org or 919-251-9680 (Farm Energy Team Leader)

Farm Energy resources: www.attra.org/energy